

Printed Pages: 02

Paper Id: 110257

Sub Code: RCS403

Roll No.

B TECH

(SEM-IV) THEORY EXAMINATION 2018-19  
THEORY OF AUTOMATA AND FORMAL LANGUAGES

Time: 3 Hours

Total Marks: 70

Note: Attempt all Sections. If require any missing data; then choose suitably.

## SECTION A

1. Attempt all questions in brief. 2 x 7 = 14

- For the given language  $L_1 = \epsilon$ ,  $L_2 = \{a\}$ ,  $L_3 = \emptyset$ . Compute  $L_1 L_2^* \cup L_3^*$ .
- Design a FA to accept the string that always ends with 101.
- Write regular expression for set of all strings such that number of a's divisible by 3 over  $\Sigma = \{a,b\}$
- Construct the CFG for the Language  $L = \{a^{2n}b^n \mid n \geq 3\}$ .
- What do you mean by  $\epsilon$ -Closure in FA?
- Explain Universal TM.
- Explain Two Stack PDA.

## SECTION B

2. Attempt any three of the following: 7 x 3 = 21

- Construct a minimum state DFA from given FA

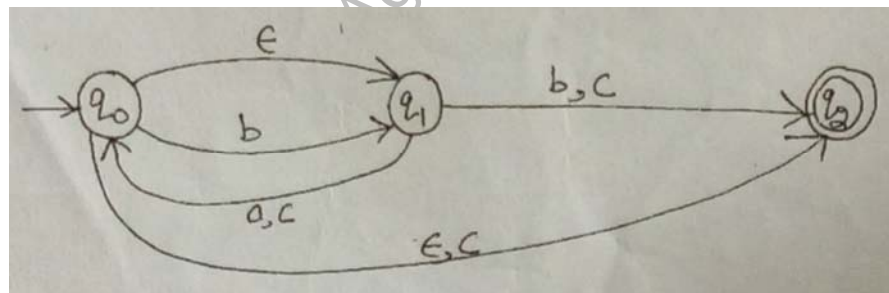


Fig. 1

- Find the regular expression corresponding to the finite automata given below:

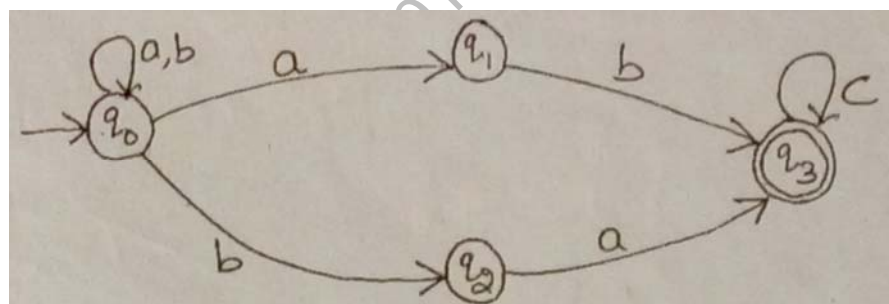


Fig. 2

P.T.O

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- c. Convert the following CFG to its equivalent GNF:  
 $S \rightarrow AA \mid a, A \rightarrow SS \mid b.$
- d. Design a PDA for the following language:  
 $L = \{a^i b^j c^k \mid i = j \text{ or } j = k\}$
- e. Design a TM for the following language:  
 $L = \{a^{n+2} b^n \mid n > 0\}$

## SECTION C

3. Attempt any *one* part of the following: 7 x 1 = 7
- (a) Design FA for ternary number divisible by 5.  
 (b) Explain Myhill-Nerode Theorem using suitable example.
4. Attempt any *one* part of the following: 7 x 1 = 7
- (a) Prove that the following Language  $L = \{a^n b^n\}$  is not regular  
 (b) Explain the Closure properties of regular expression.
5. Attempt any *one* part of the following: 7 x 1 = 7
- (a) Design the CFG for the following language:  
 i)  $L = \{0^m 1^n \mid m \neq n \ \& \ m, n \geq 1\}$   
 ii)  $L = \{a^l b^m c^n \mid l + m = n \ \& \ l, m \geq 1\}$   
 (b) Prove that the following Language  $L = \{a^n b^n c^n\}$  is not Context Free.
6. Attempt any *one* part of the following: 7 x 1 = 7
- (a) Design a PDA for the Language  $L = \{WW^R \mid W = \{a, b\}^*\}$   
 (b) Generate CFG for the given PDA M is defined as  
 $M = (\{q_0, q_1\}, \{0, 1\}, \{x, z_0\}, \delta, q_0, z_0, q_1)$  where  $\delta$  is given as follows:  
 $\delta(q_0, 1, z_0) = (q_0, xz_0)$   
 $\delta(q_0, 1, x) = (q_0, xx)$   
 $\delta(q_0, 0, x) = (q_0, x)$   
 $\delta(q_0, \epsilon, x) = (q_1, \epsilon)$   
 $\delta(q_1, \epsilon, x) = (q_1, \epsilon)$   
 $\delta(q_1, 0, x) = (q_1, xx)$   
 $\delta(q_1, 0, z_0) = (q_1, \epsilon)$
7. Attempt any *one* part of the following: 7 x 1 = 7
- (a) Design a TM for the following language:  
 $L = \{a^n b^n c^n \mid n \geq 1\}$   
 (b) Write short note on:  
 i) Recursive Language and Recursively Enumerable Language.  
 ii) PCP problem and Modified PCP Problem